DOCUMENT RESUME

ED 186 235 SE 030 538

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TITLE Report on the Conference on Physics Teaching Held at the Weizmann Institute of Science, Rehovot, Israel, August 19-24, 1979.
PUB DATE Sep 79
NOTE 5p.; For related document, see SE 030 537. Not available in hard copy due to marginal legibility of original document.

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Computer Assisted Instruction; *Educational Improvement; Elementary School Teachers; *Higher Education; Instructional Materials; *Physics; Science Instruction; Scientific Concepts; Social Problems; *Teacher Education; *Teaching Methods; Technology

ABSTRACT

This report discusses the current problems in teaching physics to teachers and new techniques for teaching vibrations and waves to students with limited mathematical ability. The author summarizes the topics covered at the Conference within the two categories. (SA)

Report on the Conference on Physics Teaching

held at the Weizmann Institute of Science, Rehovot, Israel,

August 19th-24th 1979

The Conference organised by the International Group for the Advancement of Physics Teaching (GIREP) was based on two main themes:- Oscillations and Waves, and Current Problems in Physics Teaching.

The contributions towards these two topics covered a wide range of subjects, both within Vibration and Waves Teaching and in the wider context of teaching to mixed ability, socially, culturally and educationally deprived groups of students.

Current Problems in Physics Teaching

In the opening session John Lewis (Malvern College) stressed the need for more emphasis in schools on pure science education to change the present popularity trend which is currently towards the Arts and Social Sciences. One of the major problems which was discussed during this and other sessions was the lack of training many teachers had in teaching science, which produces a continuous cycle of a population of inadequately trained teachers. Suggestions were made that science subjects should be more closely linked with society's problems to give more meaning to the study of pure sciences to a wider section of students. More ideas to improve the teaching of science are discussed later in this report.

Several contributions, (Gael, Goldring, Mikelskis and Paulsen) proposed that the separation of Physics Instruction from everyday social and technological problems actually experienced by students, is causing the subject to be rejected by many students. Alternative approaches to the traditional Physics instruction were proposed to bridge the gap between the Natural and Social Sciences. It was proposed that controversial topics covering the role of Physics and physicists in society should be included in Physics courses.

Several papers were presented which discussed the reasons for and benefits of teaching Physics to disadvantaged students. One of the problems of teaching Physics to disadvantaged students is that they are less able to make abstractions therefore the teacher must use methods which associate the abstract concept with the concrete physical experiment. These authors* presented ideas for teaching materials, which, it was hoped, would provide the optimal characteristics and structure of learning tasks pertaining to the cognitive and motivational level of the disadvantaged students. To overcome the problems of teaching disadvantaged students one approach (Schuster) was to use a self-paced Mastery learning course to give the maximum flexibility for students of diverse background. Another (Eisenberg, Fresko and Carnelli) was to match 3000 school children on a one to one tutorial basis with 3000 University students. Although in the latter case a two year evaluation study showed few cognitive gains made by the children, both children and tutors felt a high degree of satisfaction from the links made. These are only two examples of many ideas discussed on teaching to disadvantaged students.

Several contributors described educational material which they were using to enhance the more conventional teaching methods. These materials included:-

Gaming Techniques (Ellington et. al).
which involved students competing in groups to find the most satisfactory solution to a simulated physical situation.
Computer Assisted Learning (Cox and Lewis)
using CAL to widen the scope etc., of a Vibrations and Waves Course.
Experiments on Films (Higatsberger)
using short films of experiments rather than the experiments themselves (usually used for demonstration purposes) during a lecture course.

The problems raised by teaching to mixed ability groups is forcing

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* Aarons, Bransky and Suztover, Cox and Lewis, Even, Finegold, McDermott, Orpaz and Dori, Palma-Vittandli, Schuster, Watis, Weiss.

teachers to rethink the type of Physics we should be teaching, what kind of instruction is likely to be the most effective, and what methods of assessment should we be using with the type of students we have today.

Vibrations and Waves

Many contributors provided new ideas for teaching different aspects of Vibrations and Waves, with descriptions of different experiments and physical techniques to overcome the restrictions usually imposed by the mathematical limitations of the students. Examples of the work described included:-

teaching the origin of the sonic bang (Dreyfus) using a computation of the time of flight of "sound particles".

using a programmable pocket calculator (Mendoza) to solve an equation of motion using a numerical method.

teaching interference of light using a beam splitter (Haber-Schaim).

using waves as messengers - Probes (French) to carry information and learn about objects which cannot be explored by contact.

demonstrating wave properties (Black and Ogborn) using water troughs to obtain dynamic rather than static conditions in wave propagation.

using computer assisted learning packages to help students overcome their mathematical limitations and to grasp the physical meaning behind the theory (Cox and Lewis).

In view of the drastic changes in optics largely as a result of the availability of coherent light from lasers, it was proposed by several participants† that a new approach to teaching optics should be adopted. This should involve more emphasis on the experimental physical aspects rather than the mathematical analyses of physical systems.

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† Cohen, Sharen, Taylor, Themser

During the conference, which lasted a week, the exhibition was open from 8.30 - 4 p.m. every day. The CAL exhibition from Surrey produced considerable interest from many of the participants. As there was only one representative from Surrey, and no time was set aside during the conference specifically for the exhibition, it was not possible to demonstrate CAL material to every interested person. However, I was the only participant amongst 120 people with a reasonable amount of experience in CAL. It was obviously a new idea to many of the participants and we received a number of requests for further information, for further contact in the form of workshop demonstrations, and in some cases for software, from representatives of Institutions in Israel, Germany, Spain, Denmark, Mexico and the U.S.A. The following participants particularly expressed a wish for further information and collaboration:-

Dr. F. Grünberg, Weizmann Institute, Israel,
Prof. H. Brockmeyer
Dr. J. Summers, Facultad de Ciencias, Universidad a Distancia Ciudad. Madrid, Spain
Dr. F.R. Royo, Departamento de Fisica, Universidad de la Laguna, Tenerife, Spain,
Dr. C. Hanke, Danmarks Ingenior Akademi, Denmark
Dr. J. Barojas, Physics Dept. UAM - Iztapalapa, Mexico
Mr. Z. Solov, Ma'ale Hab'sor, Regional High School, Israel
Dr. M.A.R.P. de Barros. Physics Dept. Faculdade de Ciencias do Porto, Portugal
Prof. A.P. French, Physics Dept. M.I.T. U.S.A.
Dr H. Ellington, Ed. Tech. Unit. Robert Gordon's Institute of Technology, Aberdeen, Scotland.

It had originally been my intention to visit several educational Institutions during my stay in Israel. However as most of these Institutions were being represented at the Conference on Physics Teaching I decided that it would be more effective and less expensive to take the CAL demonstration only to Rehovot and provide an exhibit throughout the duration of the Conference.

Margaret Cox

Sept. 1979